

CLAIMS

What is claimed is:

1. A threaded fastener comprising:
5 a head;
a tip; and
a threaded shank extending between the head and the tip, the threaded shank having
a helical lead formed thereon, the lead including a plurality of bosses therealong, successive
bosses being separated from one another by recessed bases, each boss extending radially
10 beyond adjacent bases and presenting a respective profile including a lead-in profile in a
direction towards the tip, a respective lead-out profile in a direction towards the head and a
central section of substantially uniform radial dimension.
2. The fastener of claim 1, wherein the respective profiles of at least two bosses
15 differ from one another.
3. The fastener of claim 2, wherein the respective lead-in profiles of the at least
two bosses differ from one another.
- 20 4. The fastener of claim 2, wherein the respective lead-out profiles of the at
least two bosses differ from one another.
5. The fastener of claim 2, wherein the respective profiles differ from one
another in length.
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6. The fastener of claim 1, wherein at least two bases differ from one another.
7. The fastener of claim 6, wherein the at least two bases differ from one
another in length.

8. The fastener of claim 1, wherein for at least one of the bosses the lead-in profile differs from the lead-out profile.

5 9. A threaded fastener comprising:

a head;

a tip;

a threaded shank extending between the head and the tip;

10 a first helical lead formed on the shank and including a plurality of first bosses therealong, successive first bosses being separated from one another by first bases, each first boss extending radially beyond adjacent first bases and presenting a respective profile including a lead-in profile in a direction towards the tip, a respective lead-out profile in a direction towards the head; and

15 a second helical lead including a plurality of second bosses therealong, successive second bosses being separated from one another by second bases, each second boss extending radially beyond adjacent second bases and presenting a respective profile including a lead-in profile in a direction towards the tip, a respective lead-out profile in a direction towards the head.

20 10. The fastener of claim 9, wherein profiles of at least two bosses of the first lead differ from one another and profiles of at least two bosses of the second lead differ from one another.

25 11. The fastener of claim 10, wherein the respective lead-in profiles of the at least two bosses of the first and second lead differ from one another.

12. The fastener of claim 10, wherein the respective lead-out profiles of the at least two bosses of the first and second lead differ from one another.

13. The fastener of claim 10, wherein lead-in profiles of the first lead and lead-out profiles of the second lead are disposed at corresponding locations along the shank between the tip and the head.

5 14. The fastener of claim 13, wherein lead-out profiles of the first lead and lead-in profiles of the second lead are disposed at corresponding locations along the shank between the tip and the head.

10 15. The fastener of claim 10, wherein the first bosses and the second bases are disposed at corresponding locations along the shank between the tip and the head.

16. The fastener of claim 15, wherein the second bosses and the first bases are disposed at corresponding locations along the shank between the tip and the head.

15 17. The fastener of claim 10, wherein the profiles of the first and second leads are configured to provide a substantially constant insertion torque.

16. A double-lead threaded fastener comprising:

18 a tip;

20 a head;

a shank extending between the tip and the head;

a first helical lead disposed about the shank and including first bosses separated by first bases, the first bosses extending radially beyond the first bases; and

25 a second helical lead disposed about the shank and including second bosses separated by second bases, the second bases extending radially beyond the second bases;

wherein the first bosses and the second bases are disposed along the shank at generally corresponding locations, and the second bosses and the first bases are disposed along the shank at generally corresponding locations.

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17. The fastener of claim 16, wherein each of the first and second bosses includes a respective lead-in profile and lead-out profile, and wherein the lead-in profiles of the first bosses and the lead-out profiles of the second bosses are disposed at generally corresponding locations along the shank, and the lead-out profiles of the first bosses and the lead-in profiles of the second bosses are disposed at generally corresponding locations along the shank.

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18. The fastener of claim 17, wherein the lead-in profiles of at least two of the bosses of the first and the second leads are different from one another.

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19. The fastener of claim 17, wherein lead-out profiles of at least two of the bosses of the first and second leads are different from one another.

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20. The fastener of claim 16, wherein the first and second bosses and the first and second bases are disposed along the shank to provide a substantially constant insertion torque.

²¹
21. The fastener of claim 17, wherein the lead-in profiles of the bosses of the first and second leads are inclined less than the lead-out profiles for the same bosses.

²²
22. The fastener of claim 16, wherein the first lead is identical to the second lead.

²³
23. A double-lead threaded fastener comprising:
a tip;
a head;
a shank extending between the tip and the head;
a first helical lead disposed about the shank and including first bosses separated by first bases, the first bosses extending radially beyond the first bases; and

a second helical lead identical to the first helical lead, the second helical lead being disposed about the shank and including second bosses separated by second bases, the second bases extending radially beyond the second bases;

5 wherein the respective first and second bosses are displaced from one another by 180 degrees at generally corresponding locations along the shank.

24. The fastener of claim 23, wherein each of the first and second bosses includes a respective lead-in profile and lead-out profile, and wherein the lead-in profiles of the first bosses and the lead-out profiles of the second bosses are disposed at generally corresponding locations along the shank, and the lead-out profiles of the first bosses and the lead-in profiles of the second bosses are disposed at generally corresponding locations along the shank.

25. The fastener of claim 24, wherein the lead-in profiles of at least two of the bosses of the first and the second leads are different from one another.

26. The fastener of claim 24, wherein lead-out profiles of at least two of the bosses of the first and second leads are different from one another.

27. The fastener of claim 23, wherein the first and second bosses and the first and second bases are disposed along the shank to provide a substantially constant insertion torque.

28. The fastener of claim 24, wherein the lead-in profiles of the bosses of the first and second leads are inclined less than the lead-out profiles for the same bosses.

29. The fastener of claim 23, wherein profiles of bosses of the first and the second leads vary along the shank from the tip to the head.

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30. A double-lead threaded fastener comprising:

a tip;

a head;

a shank extending between the tip and the head;

5 a first helical lead disposed about the shank and including first bosses separated by first bases, the first bosses extending radially beyond the first bases and less than a 360 degrees around the shank; and

a second helical lead identical to the first helical lead, the second helical lead being disposed about the shank and including second bosses separated by second bases, the
10 second bases extending radially beyond the second bases and less than 360 degrees around the shank;

wherein the respective first and second bosses are displaced from one another by 180 degrees at generally corresponding locations along the shank.

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15 31. The fastener of claim 30, wherein each of the first and second bosses includes a respective lead-in profile and lead-out profile, and wherein the lead-in profiles of the first bosses and the lead-out profiles of the second bosses are disposed at generally corresponding locations along the shank, and the lead-out profiles of the first bosses and the lead-in profiles of the second bosses are disposed at generally corresponding locations along
20 the shank.

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32. The fastener of claim 31, wherein the lead-in profiles of at least two of the bosses of the first and the second leads are different from one another.

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25 33. The fastener of claim 31, wherein lead-out profiles of at least two of the bosses of the first and second leads are different from one another.

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34. The fastener of claim 30, wherein the first and second bosses and the first and second bases are disposed along the shank to provide a substantially constant insertion torque.

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35. The fastener of claim 31, wherein the lead-in profiles of the bosses of the first and second leads are inclined less than the lead-out profiles for the same bosses.

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36. The fastener of claim 30, wherein profiles of bosses of the first and the second leads vary along the shank from the tip to the head.

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37. The fastener of claim 30, wherein each of the first and second bosses extends less than 180 degrees around the shank.

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15 38. The fastener of claim 37, wherein each of the first and second bosses extends less than 90 degrees around the shank.

⁴¹
20 39. A method for making a threaded fastener, the method comprising:
forming a roll threading die, the die including recesses for forming first and second leads on a fastener blank, each lead including a plurality of bosses separated by bases, the bosses extending radially beyond the bases; and
roll threading the first and second leads on a fastener blank.

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25 40. The method of claim 39, wherein the die is formed to roll identical first and second leads.

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41. The method of claim 40, wherein the die is formed to roll bosses of the first lead at locations along the blank corresponding to locations of bases of the second lead, and bosses of the second lead at locations along the blank corresponding to locations of bases of the first lead.

42. The method of claim 41, wherein each of the bosses includes a lead-in profile and a lead-out profile, and wherein the die is formed such that lead-in profiles of bosses of the first lead are formed along the blank at locations corresponding to lead-out profiles of the second lead, and lead-in profiles of the second lead are formed along the blank at locations corresponding to lead-out profiles of the first lead.

43. The method of claim 39, comprising the further step of forming a die-making tool, and wherein the die is formed by electric discharge machining utilizing the die-making tool.

44. The method of claim 43, wherein the die-making tool is formed by milling.

45. The method of claim 43, wherein the die-making tool is made of graphite.

46. A method for making a threaded fastener, the method comprising steps of:
forming a roll threading die, the die including recesses for forming identical first and second leads on a fastener blank, each lead including a plurality of bosses separated by bases, the bosses extending radially beyond the bases; and
roll threading the first and second leads on a fastener blank to form the first and second leads at locations 180 degrees displaced from one another.

47. The method of claim 46, wherein the roll threading die is formed by electric discharge machining.

48. The method of claim 46, wherein die is configured such that lead-in profiles of bosses of the first lead are disposed at locations along the resulting fastener corresponding to locations of lead-out profiles of bosses of the second lead.

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49. The method of claim 46, wherein the die is configured such that the first and second leads are identical to one another.

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50. A threaded fastener comprising:
5 a head;
a tip; and
a threaded shank extending between the head and the tip, wherein a ratio of pullout torque to insertion torque is greater than 0.8.

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10 ⁵¹. The threaded fastener of claim 50, wherein the ratio is greater than 0.9.

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52. The threaded fastener of claim 51, wherein the ratio is greater than 1.0

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15 ⁵³. The threaded fastener of claim 52, wherein the ratio is greater than 1.1.

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54. The threaded fastener of claim 50, wherein the fastener comprises first and second leads about a shank, each lead having a series of bosses, lead-in profiles and lead-out profiles of the bosses differing from one another to provide the ratio.

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20 ⁵⁴. The threaded fastener of claim 54, wherein the first and second leads are identical to one another.

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25 ⁵⁵. The threaded fastener of claim 54, wherein crests of the lead-in profiles are inclined at approximately 15 degrees from the thread root, and crests of the lead-out profiles are inclined at approximately 45 degrees from the thread root.

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57. A tool for forming a threaded fastener, the tool comprising a roll threading die having a series of grooves formed therein for forming first and second leads on a fastener blank, the first and second leads each having a series of bosses separated by bases.

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~~58.~~ The tool of claim 57, wherein the first and second leads are identical to one another.

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~~59.~~ The tool of claim 57, wherein the bosses of the first and second leads present lead-in profiles and lead-out profiles, and wherein the grooves are configured to form the first and second leads such that lead-in profiles of bosses of the first lead are disposed at locations corresponding to locations of lead-out profiles of bosses of the second lead along the blank.

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~~60.~~ The tool of claim 59, wherein the lead-in profiles are different from the lead-out profiles.